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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/710,628	11/08/2000	Sien G. Kang	18419-008210US	5772

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EXAMINER
RAO, SHRINIVAS H

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 09/13/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Offic Action Summary	Application No.	Applicant(s)	
	09/710,628	KANG ET AL.	
	Examiner	Art Unit	
	Steven H. Rao	2814	

-- The MAILING DATE of this communication appears on the c ver sheet with the c rrespondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 May 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

Resp nse to Amendment

Applicants' amendment filed May 13, 2002 has been entered on July 16, 2002.

Therefore claims 1,5, 11-12 and presently newly added claims 19-22 as recited in the amendment and claims 2-4, 6-10 and 13-18 as originally recited are currently pending in the application.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 19 and 22 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 19 and 22 recite " wherein the substrate is a silicon substrate having (100) crystal orientation."

The specification as originally filed does not surface in a thermal setting of a temperature of about 1,000 degrees Celcius or greater.

namely that the substrate has (100) crystal orientation.

With respect to claims 20 to 22, claims 20 and 22 recite, " silicon- containing – deposition species".

To the extent Applicants' intend to claim species other than SiH_4, $Si_xCl_yH_z$ and $SiCl_x$, those species were not described in the specification in such a way as to

reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 21 depends upon claim 20 and is rejected for at least that reason.

With respect to claim 21 it recites," wherein the combination of the deposition species and the etching species are contacting the non-uniform surface in a thermal setting of a temperature of about 1,000 degrees Celcius or greater.

To the extent applicants' intend to claim the species contacting the surface surface in a thermal setting of a temperature of about 1,000 degrees Celcius or greater, this is not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. (it is noted that claim 2 recites the thermal setting increases a temperature of the non-uniform surface to about 1,000 Degrees Celsius and greater , which is completely different scope than the presently recited claim 21).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al. (U.S. Patent No. 5,869,387, herein after Sato) for reasons previously set out

and incorporated here by reference for the sake of brevity and for the reasons set out below.

Applicants' state that their claim recites :

"..applying a combination of a deposition species for deposition of a deposition material and an etching species for etching an etch able material, the combination of the deposition species and the etching species contacting the non-uniform surface in a thermal setting to reduce a level of non-uniformity of the non-uniform surface by filling a portion of the defects to smooth the film material...".

and conclude Sato does not disclose or teach at least the above recited features.

However, Sato as shown below teaches/ discloses the above in addition to the teachings stated in the last Office Action.

Sato in col. 9 lines 5- 55 states :

The porous monocrystalline Si was found in the course of study on electropolishing of semiconductors in the year 1956 by A. Uhlir et al. (A. Uhlir et al.: Bell Syst. Tech. J., vol. 35, p. 333 (1956)). The dissolving action of Si in anodization was studied by Unagami, who reported that positive holes are required for anodic reaction of Si in an HF solution and the reaction proceeds according to the formulas below (T. Unagami: J. Electrochem. Soc., vol. 127, p. 476 (1980):

$$Si+2HF+(2-n)e^{+} \rightarrow SiF_2+2H^{+}+ne^{-}$$

$$SiF_2+2HF \rightarrow SiF_4+H_2$$

$$SiF_4+2HF \rightarrow H_2SiF_6$$

or otherwise,

$$Si+4HF+(4-\lambda)e^{+} \rightarrow SiF_4+4H^{+}+\lambda e^{-}$$

$$SiF_4+2HF \rightarrow H_2SiF_6$$

where e^{+} and e^{-} represent respectively a positive hole and an electron; n and λ represent respectively the number of the positive holes required for dissolving one atom of monocrystalline Si, and it was also reported that porous monocrystalline Si is formed if $n>2$, or $\lambda>4$.

Accordingly, a P-type Si having positive holes is considered to be more readily made porous. This selectivity in porous structure formation has already been actually proved by Nagano et al. (Nagano, Nakajima, Yasuno, Ohnaka, and Kajihara: Densi Tsushin Gakkai Gijutsu Kenkyu Hokoku (Technical Bulletin of Electronic Communication Society) vol. 79, SSD 79-9549 (1979)) and K.Imai: Solid State Electronics, vol. 24, p. 159 (1981)). Thus, P-type silicon having positive holes can be selectively made porous.

On the other hand, it was also reported that high-concentration N-type monocrystalline Si can also be made porous (R. P. Holmstorm, I. J. Y. Chi: Appl. Phys. Lett. vol. 42, p. 386 (1983)). Therefore it is important to select the substrate capable of being made porous, regardless of whether the structure is of P-type or of N-type.

Subsequently, a thin monocrystal layer 202 is formed on the porous substrate surface by epitaxial growth according to various growth methods.

In the porous Si layer, pores of about 600 Å in average diameter are formed according to observation with transmission electron microscopy. Although the density thereof is half or less than the density of monocrystalline Si, the monocrystallinity is retained, and epitaxial growth of monocrystalline Si is practicable on the surface. However, rearrangement of the internal pores occurs at a temperature above 1000° C., which impairs the characteristics of enhanced etching.

Therefore Sato teaches a deposition species for deposition of a deposition material.

Sato in col. 10 lines 59 to col. 11 line 15 states :

The known methods for the etching of porous Si include:
(1) Etching of porous Si with an aqueous NaOH solution (G. Bonchil, R. Herino, K. Barla, and J. C. Pfister: J. Electrochem. Soc., vol. 130, no. 7, p. 1611 (1983)), and
(2) Etching of porous Si with an etching solution capable of etching monocrystalline Si.

In the above method (2), a hydrofluoric nitric acid type etching solution is used normally. With this etching solution, the etching proceeds through oxidation of Si by nitric acid to form SiO_2 and subsequent etching of the resulting SiO_2 with hydrofluoric acid as shown below:

The known methods for etching crystallire Si include etching with an ethylenediamine type, KOH type, or hydrazine type of etching solution as well as the above hydrofluoric nitric acid type etching solution.

The selective etching of porous Si, which is particularly effective and important in the present invention, employs hydrofluoric acid or a buffered hydrofluoric acid which does not have etching action for crystalline Si. In this etching, an aqueous hydrogen peroxide solution may be used additionally as an oxidizing agent. The reaction rate can be controlled by changing the ratio of addition of the hydrogen peroxide. An alcohol may be added which serves as a surface active agent to remove instantaneously the bubbles of the gaseous reaction product from the etching surface, and enables selective etching of porous Si uniformly and efficiently.

Therefore Sato also teaches, "and the etching species contacting the non-uniform surface".

Sato in col. 7 lines 64 to col. 8 lines 21 states :

In FIGS. 1A and 1B, the numeral **101** denotes a substrate; **102**, roughness on the surface of the substrate; **103**, a surface state before the heat treatment; and **104**, a surface state after the heat treatment. In the case where the surface roughness is eliminated by polishing, the thickness of the monocrystal layer may vary in the plane. On the contrary, in the heat treatment in a reducing atmosphere of the present invention, the fine roughness only is removed, but the thickness of the monocrystal itself does not vary. Accordingly, the surface flattening by the heat treatment does not cause additional thickness variation.

It was found that the surface roughness of monocrystalline silicon having a roughness of about several nm to several tens of nm in terms of the p-v value in a cycle of several nm to several hundreds of nm (FIG. 1A) can be flattened by heat treatment in a reducing atmosphere to a p-v value of several nm or less, or 2 nm or less under optimum conditions (FIG. 1B) as shown by the numeral **104** in FIG. 1B, which is the same flatness level as monocrystalline silicon wafer. This phenomenon is considered to be reconstruction of the surface rather than etching. On a rough surface, a number of edge-shaped portions exist which have high surface energy, and faces of higher order of orientation than the plane orientation of the crystal layer are exposed in great numbers on the surface. The surface energy in such

Therefore Sato teaches, " thermal setting to reduce a level of non-uniformity of the non-uniform surface by filling a portion of the defects to smooth the film material...".

Therefore all of the presently recited limitations are taught by Sato.

Therefore all the presently recited limitations of claim 1 are taught by the applied reference Sato.

Dependent claims 2-18 were alleged to be allowable because they depend upon allegedly allowable claim1.

However, as seen above claim 1 is not allowable, therefore claims 2-18 are also not allowable and rejected for reasons previously set out and those stated above.

B. Presently new claims 19-22.

With respect to claim 19, assuming arguendo that no new matter rejection exists, wherein the substrate is a silicon substrate having (100) crystal orientation. (Sato page 2 citing Journal of Applied Physics 1 June 1990).

With respect to claim 20, wherein the method of fabricating the substrate includes the steps of : providing a substrate comprising a film of material with a non-uniform surface, the non-uniform surface including a plurality of defects, at least some of the defects being 100 Angstroms or greater (Sato fig. 1A # 102, col. 7 lines 65 and col. 2lines 9-11) and applying simultaneously to the non-uniform surface a combination of a silicon-containing deposition species for deposition of a deposition material in order to smooth the surface, assuming arguendo that no new matter rejection exists, (Sato

col.9 lines 5-55, col. 10 lines 59 to col. 11 line 5 and col.7 line 64 to col. 8 line 21) it is noted current case is :

The performance of two steps simultaneously, which have previously been performed in sequence was held to have been obvious. In re Tantincloux, 108 USPQ 125 (CCPA 1955), further, " As a matter of fact selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. In re Burhaus, 154 F.2d 690, 69 USPQ 330 (CCPA 1946).

With respect to claim 21, wherein the combination of the deposition species and etching species are contacting the non-uniform surface in a thermal setting of a temperature of about 1,000 degrees Celcius or greater assuming arguendo that no new matter rejection exists, Sat col. 2 lines 47, claim 23, etc.).

With respect to claim 22, assuming arguendo that no new matter rejection exists, wherein the fabricating method includes the steps of : providing a silicon substrate comprising a film of material with a non-uniform surface, the non-uniform surface including a plurality of defects, at least some of the defects being 100 Angstroms or greater (Sato fig. 1A # 102, col. 7 lines 65 and col. 2lines 9-11), the silicon substrate having (100) crystal orientation, the non-uniform surface including particles derived from hydrogen gas during an implantation process (Sato page 2 citing Journal of Applied Physics 1 June 1990 and claim 1 etc.) and applying simultaneously to the non-uniform surface a combination of a silicon-containing deposition species for deposition of a deposition material and a Halogen –containing-etching species for etching an etch able material in order to smooth and reduce a level of non-uniformity of the non-uniform

surface, the halogen –containing etching species including HCl (Sato col.9 lines 5-55, col. 10 lines 59 to col. 11 line 5 and col.7 line 64 to col. 8 line 21)

Response to Arguments

Applicant's arguments filed 5/13/ 2002 have been fully considered but they are not persuasive for reasons set out in detail above.

As the same reference as previously used are also used here this forma a separate basis for making this action Final.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action.

Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communication from the examiner should be directed to Steven H. Rao whose telephone number is (703) 306-

5945. The examiner can normally be reached on Monday- Friday from approximately 7:00 a.m. to 5:30 p.m.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 308-0956. The Group facsimile number is (703) 308-7724.

Steven H. Rao

Patent Examiner

September 9, 2002.

OLIK CHAUDHURI
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